SOLAR POWER CALCULATION USING MPPT AND DVFS ALGORITHM

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Abstract— **A Solar panel is a proficient power hotspot for the creation of electrical energy for extended years. Any deformity to solar cell panel surface prompt for decreased making of power and loss in the yield. Subsequently, the location of cracks on solar panel surfaces is the greatest essential stride during the inspection of solar panel, and it has main implication. In any case, these strategies cost lots of computation time and with low precision. Aiming for a few issues of the main method, a new framework is proposed to distinguish the cracks. Crack can be distinguished by utilizing optimization techniques based on segmentation. It is important to identify the crack in solar panel cells since they can directly diminish the execution of the panel and additionally the power yield. In view of the segmentation process, the potential regions which have cracks have been found, and then distinctive optimization algorithms were run on these areas to discover crack pixels. An extensive number of trials demonstrate that, this technique procures more good and additional full crack outlines with low addition costs.**

Index Terms— **Solar cell, Particle Swarm Optimization (PSO), Differential Particle Swarm Optimization (DPSO) and Fractional Order Differential Particle Swarm Optimization (FODPSO)**

I. Introduction

Electrical energy group have been a basic issue in plane and detour hardware such as satellites. Since energy making is luxurious, renewable energy source like wind, solar energy is widely used as a suitable solution to produce electrical power. As of late, solar energy and photovoltaic has been measured as a significant electrical energy produce is reserve. It could be acquired by changing from solar energy to electrical power with high efficiency and high dependability. The deformities in photovoltaic cell [1] might be because of manufacturing failures, misusing the panel, cracks may happen through sharp objects while installation or might be transportation. Distinctive sort of solar cell product has been created with crystalline silicon where by polycrystalline solar cells are more connected to crop solar cell panels and are more prominent than single material on semiconductor ones. When solar cell be contingent on single spark or polycrystalline silicon, the most vital component is escaping product with high eminence. The most common faults in solar panels are concerned with cr acks which are found on the surface of solar cell which can cell which can prompt to loss of yield. In this case, during the assembly and generation processes, it is important to guarantee the good product. Sometimes mechanical cracks like micro cracks will happen on cell panels at any circumstance. They can specifically influence efficiency and may decrease the performance [2]. It is important to distinguish cracks on solar cell panels and thus dismiss flawed crops. Numerous techniques have been produced to review the solar cell panels, and these have distinctive strengths and short comings. Some assessment frame works includes acoustic microscopy and impact testing, audiometric pulse and thermal imaging, hyper-spectral image, fault area iridescence, resonance ultrasound trembling and image processing method to deal with solar cell that was displayed for crack finding in solar cell pieces that is necessary to locate a productive method, which will lead to nondestructive and cheap rate examination framework [4]. Micro cracks may have various defect origins and result in rather “soft” outcomes such as yield-reducing shattering of parts of the affected cell up to more severe impacts involving decreases of the short circuit current and cell efficiency. Micro cracks can also occur during manual soldering when varying thermal expansions of the copper and the silicon elements develop at temperatures above 300-degree Celsius. Those temperature differentials can lead to the formation of micro cracks in the substrate and thus result in higher cell resistance. Cracks potentially grow over a longer operational time and thus extend their malicious impact on the functionality and performance of a PV module [5].

II. Literature Survey

Li, W. Wang, et al [2] 2010, clarified the execution of an examination which depends on image processing approach. These are intensive method of crack finding on the inner edge end to take the image of the solar cell panel. They distinguished and grouped the cracks based on the grey value difference of the pixels between a region and its encompassing pixels. Their created framework comprised of image converting, altering of image, Gauss Laplacian image transformation, converging the distributed points to get a coordinated region, contour recognition to recognize the cracks which are situated on inside or edge of solar cell

M.D. Dafny Lydia, et. al [3] proposed and identify the crack in solar panel cells since they can directly diminish the execution of the panel and additionally the power yield. In view of the segmentation process, the potential regions which have cracks have been found, and then distinctive optimization algorithms were run on these areas to discover crack pixels. An extensive number of trials demonstrate that, this technique procures high accuracy and more complete crack contours with low computation costs.

Ahmed M. Atallah et al [4] details implementation of Perturb and Observe MPPT using buck and buck-boost Converters. Some results such as current, voltage and output power for each various combination have been recorded. The simulation has been accomplished in software of MATLAB Math works.

G. N. Tiwari et al [5] 2011, presented a framework in view of an image processing method to defect identification to solar system modules. These are utilized semiconductor material electroluminescence devices for detention to solar cell units. They introduced distinctive type of imperfections and characterized to black piece, wrecked grid, disintegration, and crack for solar cell unit. They planned to binary algorithm depend on conversion of a quality gray color worth diverse regions. That method to identify the crack to a wrecked grid depends on following the route; and crack are distinguished in rapports of the projection area of outermost and closest horizontal degree of respectively solar cell. Their outcomes for acknowledgment rate of deformities were introduced as subsequent: black piece 99%, cracked grid and disintegration is 95 % rate for crack discovery is 80%.

D.M Tsai et al [6] 2010, the author developed an investigation framework created for machine idea for knowing very few cracks of solar cell crackers. Their framework has an immediately calculative operation for 0.09 s to 640 *480 images.

X Z Meng et al [7] 2017, combined the advantages of each maximum power point tracking (MPPT) algorithm, put forward a kind of algorithm with higher speed and higher precision, based on this algorithm designed a maximum power point tracking controller with ARM

Fang Shuai et al [8] 2012, has proposed a framework in view of machine apparition to recognize undetectable very small crack of solar cell. To search these out, they set up an IR image framework to take images by internal very small crack. They useful flaw detection methods to extricate very small crack elements of the solar cell. These test results showed a 99.85 % precision of their finding system.

Zou Q et al [9] 2012**,** introduced a producing light material to recognize fault on solar cell in view of the current gap of intensity conveyance of electroluminescence (EL). They built up an ultraviolet thermography strategy and plan for fault recognition in solar cell panels. That framework comprised of an IR camera is instruction to take image to the solar cells and edge recognition administrator to identify the edge of cracks.

Y.C. Chiou et al [10] 2010, built up a framework that uses main estimations. Mostly non-image process test techniques are introduced by a review strategy in view of hyperspectral imaging to recognize crack are come in solar cell panels was developed. For laser, filtering was adopted to perceive the imperfections on solar cell panel.

M. Kontges et al [11] 2011, utilizes digital image processing to recognize areas in an image by utilizing different segmentation methods. This paper gives a brief record on five of the distinctive segmentation procedures namely region growing, watershed, thresholding, crack and merge, k-means clustering techniques highlighting the points of interest and the hindrances of each of these techniques. A change of traditional region growing segmentation method is presented which consequently chooses the seed points and develops the regions until all regions in the image are divided. The consequences of segmentation techniques introduced in the paper are not reliant on the type of image to be segmented and these techniques are utilized as a part of segmenting industrial radiographic weld images in which a few defects like porosity, absence of fusion, slag line, inadequate penetrations, and wormholes happens. The techniques are assessed on different types of images and efficiency of these techniques in the detection of a few weld imperfections is presented along with the experimental results.

Y.Nosakaet al [12] 2011 utilizes an arrangement of solar cells which are collected and interconnected into a large solar module to offer a lot of power for commercial applications. Numerous defects in a solar module cannot be outwardly seen with the routine CCD imaging framework. This paper goes for defect inspection of solar modules in electroluminescence EL images. The solar module charged with electrical current will radiate infrared light whose intensity will be darker for intrinsic crystal grain boundaries and extrinsic defects including microcracks. The EL image can particularly highlight the invisible defects additionally make an irregular inhomogeneous background which makes the examination task troublesome. The proposed strategy depends on Independent Component Analysis (ICA) and includes learning and detection stage. The vast solar module image is initially divided into small solar cell sub images. In the training stage, an arrangement defects free solar cell sub images is utilized to find a set of independent basis images using ICA. In the inspection stage each solar cell sub image under examination is reconstructed as a linear combination of the learned basis images. The coefficients of the linear combination are utilized as the feature vector for characterization. Likewise, test results have shown that the twin rebuilding to the main images unmistakably outperforms the ICA feature extraction approach. It can accomplish a mean acknowledgement percentage 93.4 % to set of 80 test sample.

III. Proposed Method

The crack in solar panel cell has been identified by different optimization algorithms and the crack may be there because of manufacturing defects, mishandling etc. It makes sense that for maximum power generation, each solar cell panel must be in good working condition. Once the panel is working in the field, the industry is expanding utilizing thermal imaging as its preferred strategy for finding defects [3,4]. Thermal imaging permits irregularities to be seen plainly and, unlike other techniques can be utilized to scan installed solar panels amid normal operation. It is profoundly a time effective process as a substantial region can be examined in minutes [6]. Cooled thermal imaging cameras have been utilized as a part of the innovative work of solar panel technology for a long time. However, it is the commercial uncooled technique which involves satisfying the post production, quality control and maintenance applications [7].

A. Steps of Software Component

The input image of the solar panel surface has been captured from the camera while running the MATLAB code for Particle Swarm Optimization (PSO), Differential Particle Swarm Optimization (DPSO) and Fractional Order Differential Particle Swarm Optimization (FODPSO) to recognize the crack which frequently occurs on the edges. For this situation, optimizing of edge detection will be performed on pixels from the captured image as indicated by the path of the connected curves on the image. So, the edges of regions will be recognized [3].

B. Algorithms Used

1.Particle Swarm Optimization (PSO)
2.Differential Particle Swarm Optimization (DPSO)
3.TFractional Order Differential Particle Swarm Optimization (FODPSO)

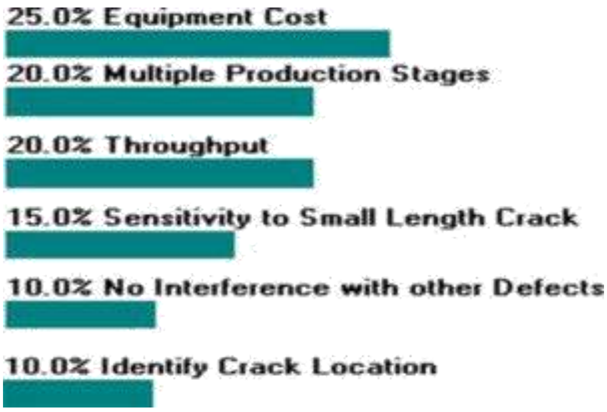

Fig. 1. Proposed criteria and relative weight used in this study.

IV. VARIOUS CRACK AND DETECTION TECHNIQUE

Microcracks adversely affect the manufacturing cost and reliability of PV modules. We have compared the weakness and strength of different NDT techniques to detect microcracks in mono and polycrystalline silicon wafers and solar cells [3,7,13]. As we have discussed in the previous section, there are many types of inspection tools used to detect microcracks. If the production line is fully automated, the inspection tools must be fast and precise. Only tools that are created on PL imaging, EL imaging, optical communication, and RUV meet these requirements [8].

However, if there is a need to detect microcracks only in the finished solar cell stage, we can use an inspection tool that is based only on EL imaging and not tools that are based on optical transmission. Should an inspection tool be required during the wafer and finished solar cell manufacturing stages, we can use PL imaging. Some commercial inspection tools that use PL imaging technology, such as that created by the BT Imaging Company formed by Bardos and Trupke [8] provide many products for inline inspection tools for both wafer and solar cells. The throughput for this tool is up to 3600 measurements per hour whereas the throughput for the commercial system [6] is between 1200-1800 measurements per hour. There are many methods for microcrack inspections, each of which has their advantages and disadvantages. In the following section, we describe for the first time that our use of a methodology to rank these various microcrack inspection tools[13]

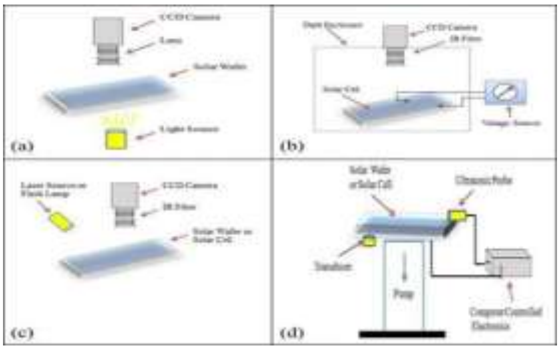

Fig.2.Alternatives are based on (a) optical transmission, (b) EL imaging, (c) PL imaging, and (d) RUV

V. SIMULATION RESULT

For the above paper, we have used MATLAB which is a multi-paradigm numerical computing environment. The effective area is the main source for the outcome of the work done. We have taken two different conditions to distinguish them based on effective area and hence carrying out the results as follows:

A. IDEAL CONDITION AREA 12WATT PANEL EFFECTIVE AREA (A=2.15)

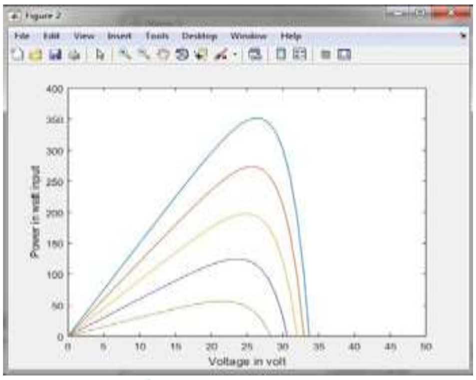

Fig. (3) Power in watt input Vs Voltage in volt.

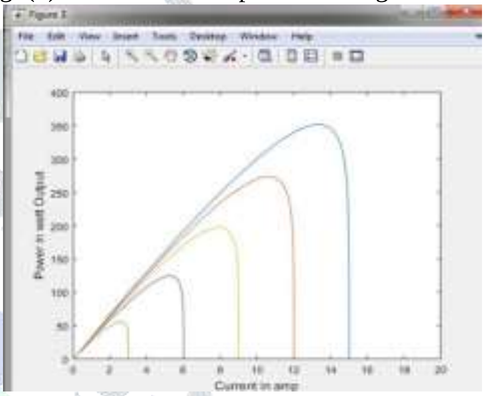

Fig. (4) Power in watt output Vs current

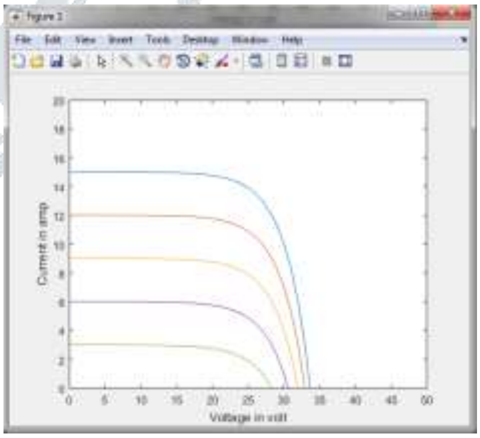

Fig. (5) Current Vs Voltage in volt.

Figure 3,4 and 5 are the results of the condition where we have taken the effective area to b 2.15 in all three cases, but the variances are because of variable input and variable output in all the cases.

B. IDEAL CONDITION AREA 12WATT PANEL EFFECTIVE AREA (A=1.00)

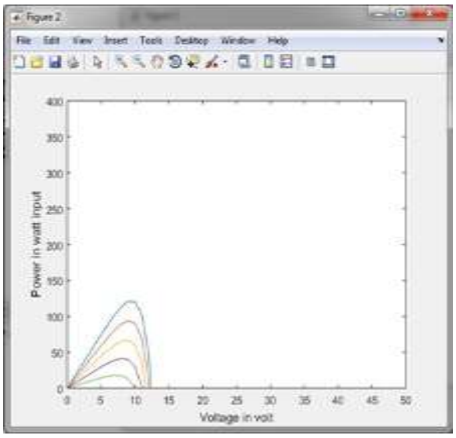

Fig. (6) Power in watt input Vs Voltage in volt.

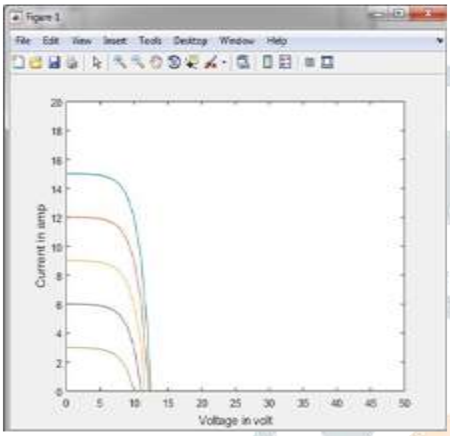

Fig. (7) Current Vs Voltage in volt.

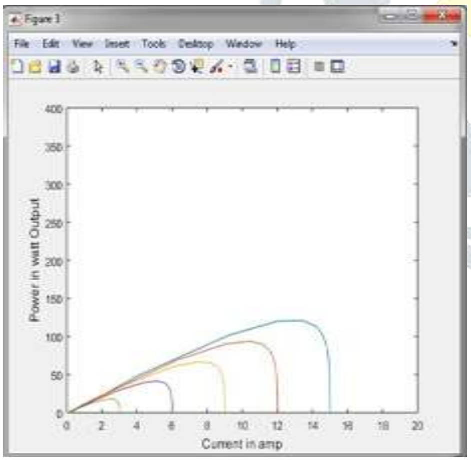

Fig. (8) Power in watt output Vs current

In figure 6, 7 and 8, we have taken the ideal condition for an effective area (A=1.00) to show that when the cracks occur then the effective area is reduced. Comparisons have been made based on input and output variances.

Table 1: TABLE SHOWING REDUCTIONS CRACK OF EFFECTIVE AREA OF SOLAR PANEL WITH REDUCTION OF SOLOR EFFICIENY

S.No	EA (M)	Vo Volt	I0 amp	Pout joule	Pin joule	IRR	η %
1	1	15	8	150	250	40	6
2	1.5	20	9	200	300	50	66.6
3	1.9	25	11	250	370	60	67.5
4	2.0	30.1	13	300	390	70	76.9
5	2.15	35	14	350	400	80	87.5

EA-effective area, Vo-Output Voltage, Io-Output current, Pout-output Power, IRR- irradiation and η-efficiency

Here, the results are taken with respect to voltage, current and power factors which are connected to one other in respective terms to get the final efficiency and irradiation factor. These results have been performed on Mat Lab tool.

C. SIMULATION WITH THE HELP OF EQUIVALENT LOGICAL COMBINATION REPRESENTION

Fig. (9) Xilinx DVFS based frequency calculation in solar crack.

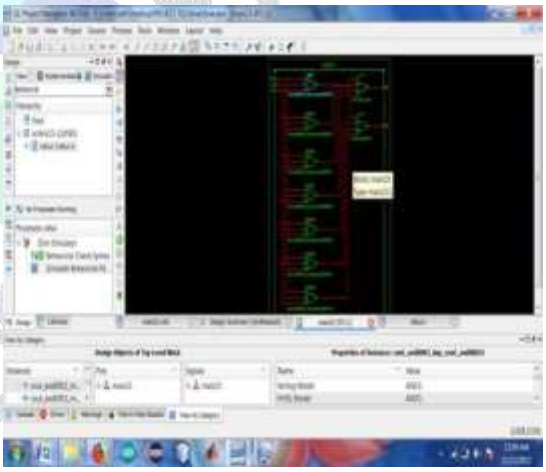

Fig. (10) Logical RTL diagram in Broad crack occurred with represents in adder with reduction of solar effective area in all solar power estimation

Fig. (11) Timing waveform in Loss occurred.

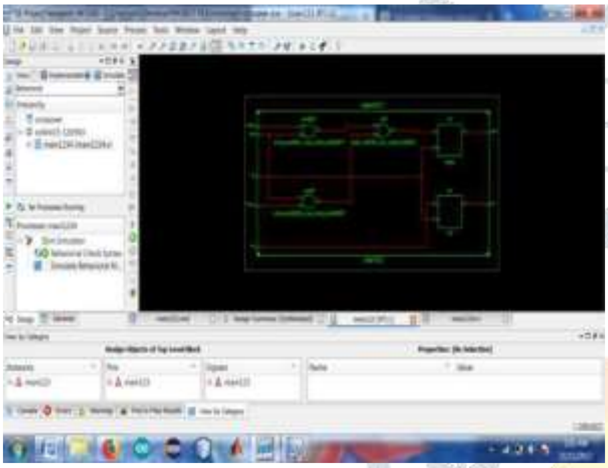

Fig. (12) Reduction Circuit diagram in Xilinx

Figure 9, 10, 11 and 12 are the results of VIVADO implementations. VIVADO is a software suite produced by XILINX for synthesis and analysis of HDL designs. Here we have used dynamic voltage-frequency scaling (DVFS) algorithm. This algorithm incorporates the power consumption in circuits.

D. POWER CALCULATION OF SOLAR PANEL CRACKS BY USING DFFV ALGORITHM FOR REFERENCE CLOCK GENERATION

The dynamic power (P_{dyn}) ingesting arises from charge and discharge of the load capacitance, the short circuit current. Leakage power (P_{leak}) arises due to leakage current which is flowing even when the device is not ready, show

$$P_{dyn} = \alpha C V^2 F$$

$$P_{leak} = I_{leak} V$$

Here α shows the swapping activity F shows the operating frequency and V shows the operating voltage leak shows the leakage current. With CMOS scaling the escape power is increase intensely.

Table 2: Operation Voltage Calculation

S.No	EA	P_{leak} (MWatt)	P_{dyn} (mWatt)
1	1	2.4	3.636
2	1.5	2.7	3.058
3	1.9	3.3	2.965
4	2.0	3.9	2.859
5	2.15	4.2	2.759

VI. CONCLUSION

The early discovery of microcracks in solar cell is vital in the production of PV modules. This paper focuses on image processing scheme composed of segmentation procedures. Since solar cell panel is considered as an efficient power source for the generation of electrical energy for long years, any defect on the solar cell panel's surface will prompt to reduce the production of power and loss in the yield [10]. The outcomes demonstrate that the segmentation procedures can detect and recognize microcrack pixels efficiently in the presence of various forms of noise. This paper provides the collective survey of the different image processing techniques used for the detection of the cracks in the engineering structures. The main intention of this study was about to study and review the crack detection system based on image processing and the same processed with the outcomes as efficiency with respect to the effective area where MATLAB has been used and next one is about power outcomes which are the results of VIVADO using DDFV algorithm. With better segmentation algorithm like threshold technique and reconstruct able feature extraction technique for the thorough damage analysis. In the future, we plan to conduct a survey on the different techniques available for invasive method-based crack detection as this work presents an extensive study over the noninvasive methods of crack detection.

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